

ROUTING AND SCHEDULING CHALLENGES FOR A SERVICE PROVIDER

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The Capacitated Vehicle Routing Problem (CVRP) and the Capacitated Vehicle Routing Problem with Time Windows (CVRPTW) are NP-complete. Real-world routing and scheduling (RS) problems tackled by enterprises today have a CVRPTW as a sub-problem. There is no single RS model that fits the requirement of all enterprises. RS software must be tailored to address the operational requirements of an enterprise and sometimes for a region of an enterprise. RS software must scale well to handle fairly large problem sizes. Some enterprises may require the software be able to solve a problem with 2500 stops, using 50 resources in less than 10 minutes on a current personal computer.

The RS solution may require generating daily routes involving single or multiple trips; or it may need to generate multiday routes, from a single depot or multiple depots. The RS solution will be required to adhere to contractual breaks for the driver for daily routes, while the multiday routes can have both daily scheduled breaks and also adhere to mandated hours of service operation rules set forth by a federal agency (such as Department of Transportation). The solution may have to adhere to any conflict rules among commodities on board. Some of the jobs may have a hazardous classification whereby a truck processing such jobs is not allowed to travel on specified roads when carrying specific hazardous materials onboard. An

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enterprise may also want to enforce some congestion factor on roads when a truck passes through urban areas during peak travel periods to factor in traffic conditions. In addition, pick-up and delivery quantities in many cases will be functions of the scheduled stops. Combining some or all of these constraints with a hard problem such as CVRPTW that can be deployed in different sectors calls for robust solution methods that are scalable.

At Descartes Systems, we have developed software for solving RS problems that uses a GRASP (Greedy Randomized Adaptive Search Procedure — a metaheuristic algorithm) in conjunction with construction and improvement heuristics to perform the assignment and routing decisions. The solutions scale up with the help of our Back Ground Optimizer (BGO). BGO generates data slices based on the problem characteristics to solve the master problem using GRASP. The BGO can also trigger improvement heuristics to arrive at a local best solution from an initial solution. The BGO can continue to work towards improving the current best solution until a user specified cutoff time. The cutoff time may be a few hours before the plan is ready for dispatch.